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THE GEOLOGICAL EDUCATION PROGRAMME OF THE GOVERNMENT OF BRAZIL AND ITS RELATIONS TO NATIONAL SCIENTIFIC DEVELOPMENT

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The geological education program of the Government of Brazil and its relation to national scientific development

by

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1. Despite its very large territory and the relatively slight knowledge of its geology and its mineral, fuels, and water resources, Brazil was estimated to have only about 200 geologists in 1956, about only half of which were active in field work, research, or teaching. Up to that time geology was taught only in schools of mining engineering, and in schools of natural history located in faculties of philosophy of Brazilian universities. In recognition of the key role of the science of geology in national development and in view of the major shortage of professional geologists, the Minister of Education and Culture in 1956 designated a commission of the nation's leading earth scientists to study the problem. The findings of the commission were accepted by the President in the same year and early in 1957 the first new geology schools began their operations. The program is known as the "Campanha para a Formação de Geologos", (CAGE) or the Campaign for the Education of Geologists, of the Brazilian Ministry of Education and Culture, and is one of the largest and most ambitious efforts directed toward education of scientists in Latin America. It is hoped that the following description and analyses of its operation and effectiveness from 1957 through 1962 will be of use to other nations undertaking comparable activities.

2. Beyond its principal objective, an acceleration and improvement in geological education, the program was designed to fit both the cultural and physical environment of the nation and to effect some changes in the prevailing Brazilian university system that might have adversely affected the education of scientists.

3. The most fundamental decision of the study commission was the creation of geology schools that for a given period of time would remain independent of the university system. Although the university system is relatively new it is part of the Federal Government, with the exception of a few State universities, and its regulations are written into Federal law, resulting in considerable rigidity. For example, the law requires that each professional degree requires a specific curriculum of studies regardless of where the degree is taken. By establishing schools operating under special decree experimentation with geology curricula was possible. Membership of the governing board of CAGE consists of the Minister and the Director of Higher Education of the Ministry of Education and Culture and three geologists, which assures both high-level educational and administrative attention and the professional experience of several of the nation's leading geologists. This broad coverage would not have been possible had the schools been established in individual universities. The measure also permitted development of faculties that were not fully subject to university requirements

for establishment of special chairs. At the same time it permitted independence from local university administrative regulations and approval from the university governing boards that consist largely of older and well-established faculties. Upon development of their own faculties, curricula, facilities, equipment, libraries, and collections, the geology schools are to be transferred to universities and CAGE will go out of existence. In effect the Ministry of Education and Culture provided special support to the new schools to permit them to develop before being incorporated into existing institutions.

4. In most Brazilian universities faculty members devote only a small part of their time to teaching and the balance to their private professional careers. This leads not only to limited contacts between faculty and students but also to restricted personal research, which in science is not conducive to development of high-level faculties. To assure full-time application to teaching and research CAGE initially established faculty salaries at levels sufficiently high to avoid dependence upon outside sources of income. Student participation in most Brazilian universities similarly apt to be on a part-time basis, which also was considered to have an unfavorable effect. CAGE therefore provided sufficient financial support to enable students to complete their courses without recourse to intervening part-time employment.

5. One of the basic decisions of the study commission was to establish a group of small schools rather than one or two large ones. This seemed necessary because of Brazil's large territorial extent. Through this dispersion it was possible to recruit students from most parts of the nation and permitted more personal attention to students by the various faculty members.

6. The use of CAGE funds for publication was designed to overcome a unique Brazilian problem, the difficulty of obtaining scientific literature and textbooks in Portuguese. Despite the existence of a relatively large Portuguese-speaking population in the world, the small number of earth scientists tends to discourage publication by private companies of original texts or translations. The bulk of the text and reference material still is in English, and students are required to study the language in conjunction with their science courses. Several schools require study of a second foreign language.

7. With these preliminary steps and decisions taken and approved, CAGE came into being late in 1956 and four schools were founded in early 1957 in the following cities: Pôrto Alegre, State of Rio Grande do Sul; São Paulo, State of São Paulo; Ouro Preto, States of Minas Gerais; and Recife, State of Pernambuco. In 1958 a fifth school came into being at Rio de Janeiro, Distrito Federal, and in the same year the University of Bahia, at Salvador, opened a school independent of the CAGE system. Their development from 1957 through 1962 varied considerably. In part this was due to the facilities initially available to each of the schools, but a wide variety of other circumstances also were involved, some foreseen and others not. A major factor affecting the entire program was a serious inflationary spiral of the national currency that resulted in a far lower level of financial support than was intended. Notwithstanding, all schools are functioning. Three schools graduated their first students in 1960 and currently are producing about 125 geologists per year, a level that will cover the requirements of industry, government surveys, and research institutes and the assistants needed in the schools themselves. Although deficiencies of various types remain the schools are initiating steps that will lead to their full intergration into the university system. By and large, therefore, it can be said that the major objectives of the study commission and CAGE are geing attained, if not at the rate and fully in the manner originally anticipated.

8. A review of the various elements and factors may clarify the problems faced in an undertaking of this scale.

9. The facilities available to the various schools in 1957 and 1958 had a considerable range. Only two, the National School of Mines at Ouro Preto, and the Departments of Geology and Mineralogy at São Paulo, had been teaching geology as a minor for an extended period of time. Both had the nuclei of good geological libraries, small but reasonably good collections of rocks, and some basic equipment for classroom, laboratory, and field instruction, and both had excellent mineralogy museums. The Institute of Natural Science at the University of Rio Grande do Sul, founded only several years before CAGE, had the beginnings of a good paleontology collection and a small reference library, as well as miscellaneous equipment in some segments of geology. In contrast the school at Recife started with almost no facilities or equipment and had to build its libraries and collections from what was locally available. All suffered from acute shortage of space for classrooms, laboratories, and faculty offices and with the exception of Rio Grande do Sul, all occupied buildings that were not constructed or designed for school use.

9a. The two schools established in 1958, the one in Rio de Janeiro supported by CAGE and the one in Salvador supported by the University of Bahia, also had widely differing facilities. Rio de Janeiro is the site of various national geological and natural science institutions, principally the Departamento Nacional da Produção Mineral and the Museu Nacional, each with large libraries and collections. These, however, are scattered throughout Rio de Janeiro and space was obtained here and there. Bahia was the only school to start with a building designed for geological instruction, the result of remodeling an old mansion with the intent of furnishing the required rooms and and laboratories needed for all phases of operations. But Bahia, as Recife, was desperately short of library material, collections, and equipment. Beyond this none of the schools had sufficient vehicles to take students to the field.

9b. These initial shortages are slowly being overcome, largely through purchases of material from abroad. The rate of acquisitions is not as satisfactory as is desired by the faculties but little can be done to accelerate purchases, principally because inflation has resulted in prohibitive costs for imported equipment, texts, and other items. Domestic financial difficulties and government regulations also produce problems in acquiring materials nationally. Nonetheless field vehicles are being obtained, since they are manufactured domestically, and exchanges between schools have broadened all collections. The requirements for surveying equipment stimulated one Brazilian manufacturer to design and produce a telescopic alidade, and other items of field and laboratory equipment are beginning to come into domestic production.

10. The major problems still lie in importation of specialized laboratory equipment and supplies and printed material. The most difficult of these, largely unsolved, is the supply of reasonably-priced textbooks for students. It is being met in part by the preparation of textbooks by various Brazilian geologists, of which a half a dozen already have been printed. The financial support for their publication comes from various government sources; in addition to CAGE, the Departamento Nacional da Produção Mineral and the Instituto de Tecnologia of the Federal Government have provided funds, as have several State organizations. Several schools have begun scientific journals which are offered in exchange for foreign journals. During the last five years the U.S. Government annually has furnished about $20,000 worth of imported equipment, collections, supplies, and printed material, and international foundations also have allocated special equipment to several schools. Foreign professors have used their international contacts to obtain other items.

11. In one way or another space is being acquired, in part through purchases of nearby buildings, its allocation by universities, or through new construction. Plans for a new geology building are approved by the University of Rio Grande do Sul, the National School of Mines at Ouro Preto and the University of Bahia; construction of a geology building has begun at São Paulo, and the school in Rio de Janeiro is acquiring an adequate block of space in the new building of the Engineering School of the University of Brazil.

12. These very large requirements for physical facilities and equipment inevitably were the result of the decision to create a group of schools rather than one central school and the same difficulties applied to the development of faculties. With the exception of professors teaching basic sciences (including physics, chemistry, and mathematics) and drawn from existing faculties in engineering schools, the available geologic manpower was barely sufficient to staff the schools. As a consequence foreign geologists residing in Brazil were invited to join the new faculties and CAGE also contracted a number of professors from abroad. Several schools also invite distinguished professors from abroad to give short series of lectures in their specialties. The technical assistance agency of the United States Government signed an agreement to furnish 8 professors for a period of 6 years (1958-1964).

13. The school best prepared for the new program was São Paulo, which had been training graduates of the geology and mineralogy departments as assistants and professors since the end of World War Two; most of them had been sent abroad on scholarships for at least a year. The cooperative agreement between CAGE and the United States Government provided for an extension of the scholarphip program to all CAGE schools and other scholarships have been available to send young assistants to various countries for one or more years. Experienced faculty members have obtained grants to visit foreign universities both from agencies of the Brazilian Government and from abroad.

13a. With the exception of São Paulo other schools had great difficulty during their first years in obtaining graduate assistants, and as a consequence still have a gap in the staffing of the intermediate professorial posts. Beginning with the graduation of their first classes, all offered faculty positions to their better students. Rio Grande do Sul has been most active in sending its young assistants abroad.

14. The inflationary situation in Brazil has imposed still other stresses on the CAGE concept of faculty development. Currently few schools are able to offer sufficient salaries to attract further professors from abroad and these now on the faculties are finding it increasingly difficult to continue in their present activities. With a depreciation of the Brazilian cruzeiro to one-tenth its value at the time the schools were established, in terms of foreign exchange, salaries have not kept pace and even Brazilian professors are having trouble continuing on a full-time basis.

15. It should be added that the CAGE schools have been getting increasing financial support from the universities. Outside of Bahia, which from the beginning was fully financed by the university, São Paulo also has funds which go directly to its geology and mineralogy departments. Most other schools, have either gotten advances or direct funds to offset delays in appropriations or reductions in the CAGE budget. These procedures are also leading toward the consolidation of the schools into their future parent organizations.

16. The original concept of a flexible curriculum has been relatively satisfactory and has resulted in considerable changes from the initially-suggested program. Among the major changes was the development of field courses and the establishment of a senior thesis based on field work as a requirement for graduation. An even more important change is the pending suggestion to extend the curriculum from four to five years and to provide for optional courses permitting specialization during the last two years of the student's tenure. Among the options to be offered will be economic geology, petroleum geology, and engineering geology, the latter embracing specialization in hydrology.

16a. Both under the initially proposed curriculum and the present concept, academic work is highly concentrated and intensive. Students are expected to spend a full eight hours in classes and laboratories, attend week-end field trips, and to take field excursions and field courses during vacation periods. Either under the old or new curricula, the first year consists of basic science, drafting and language; the following years are devoted almost exclusively to the geology with the exception of a few courses in language or surveying. There has been some question whether this approach permits enough time for independent study or laboratory and library research but there can be no question that students are getting as much geology as possible within their school years.

16b. The overall didactic approach is that of producing professional schools and that it therefore differs from systems in use in other countries. One possible shortcoming of the approach is that the student must make his decision to enter the profession at a relatively early age and it also follows that some students find themselves in a field that may not be best suited either to their talents or their inclinations. The problem is compounded by one difficulty inherent in the Brazilian system of university education, the lack of facile transfer from one course of professional study to another.

16c. Regardless of the above-listed factors, the schools are producing graduates that have excellent backgrounds for careers in earth science. It has been asserted by some foreign professors. that the upper fraction of the graduating classes are equal to geologists holding Masters Degrees in other countries.

17. A few comments may be offered regarding students and student bodies. As in any part of the world, Brazilian students entering these geology schools are a product of their culture and their pre-university education. It is clear that pre-university education in Brazil varies greatly and it is also clear that the quality of student bodies reflect the quality of their high-school training. In those parts of Brazil where large numbers of good secondary schools exist the competition for entrance is higher, and such favorable areas also produce greater numbers of candidates. One facet of pre-university education in Brazil that mitigates to some extent against ready adaptation to scientific education is the general dependence upon rote learning and memory work. Although this permits larger absorption of required memory learning, it imposes extra responsibilities on those professors who must inculcate the very essence of geological education: scientific reasoning.

17a. Another factor involved in student development is that of academic discipline, which by and large tends to be rather loose in the student's pre-university years. During the first few years of the CAGE program several serious problems arose over this subject. Although some of these crises may

have been averted had school regulations been formulated and rigorously applied, the university student does have privileges and prerogatives that do not fit easily into such regulations. Most of these problems have been resolved and there is growing realization by students and student bodies that science requires a great deal of self-discipline of mind and action.

17b. The student, in addition to his traditional rights and a general measure of protection against failure or expulsion, also can rely on his very strong student organizations, which not only involve his class and his school but also his university; student unions beyond this point also are organized up to the national level. Because of this high degree of organization, student strikes are relatively frequent. Except in certain crucial cases the principal effect in the geology schools has been a fairly substantial loss of time in formal classroom, laboratory, and field instruction.

17c. Student-faculty relationships on the whole have been relatively good and the CAGE concepts of full-time attendance by both faculties and student bodies have led to greater communication than exists in most other segments of Brazilian universities. In only one instance during the period here described was there complete and extended conflict between the student body and the faculty of one of the CAGE schools; this situation eventually required direct invervention by the Ministry of Education. It should be added that the ultimate result was salutary in that greater effort and cooperation now exist than would have been possible during the normal course of events.

18. To summarize, CAGE has achieved to a relatively good measure in its original objectives and those deficiencies still existing are more the result of external circumstances rather than internal administration. Currently three faculties are in the process of assimilation into their associated universities and the school in Bahia is receiving good support from its parent institution. Several schools are considering the eventual development of graduate faculties.

19. Although the resources of Brazil were strained to develop this number of scientific schools simultaneously, there has been one additional and outstanding result, the establishment of six dispersed centers of geological research. Faculties practicing research and students working on their senior theses currently are producing more geological mapping than Brazil has enjoyed in many years and the various journals inaugurated by these schools are greatly increasing the production of geological literature and maps. This information already is being incorporated into the national knowledge and the results being used in the compilation of national maps. Coupling this school effort with the very large absolute increase in geological manpower, Brazil now is in a position where it will be able to staff its research organizations and to begin a significant attack on the enormous problem of studying the geology and resources of the largest nation in Latin America.

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